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Access to Financing Capital by Canadian Innovative Biotechnology Firms

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Working Papers

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Symbols

The following standard symbols are used in Statistics Canada publications:

.	not available for any reference period
..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0^s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p}	preliminary
^{r}	revised
x	suppressed to meet the confidentiality requirements of the Statistics Act
^{E}	use with caution
F	too unreliable to be published

NOTE: Due to rounding, components may not add to totals

The science and innovation information program

The purpose of this program is to develop **useful indicators of science and technology activity** in Canada based on a framework that ties them together into a coherent picture. To achieve the purpose, statistical indicators are being developed in five key entities:

- **Actors**: are persons and institutions engaged in S&T activities. Measures include distinguishing R&D performers, identifying universities that license their technologies, and determining the field of study of graduates.
- **Activities**: include the creation, transmission or use of S&T knowledge including research and development, innovation, and use of technologies.
- **Linkages**: are the means by which S&T knowledge is transferred among actors. Measures include the flow of graduates to industries, the licensing of a university's technology to a company, co-authorship of scientific papers, the source of ideas for innovation in industry.
- **Outcomes**: are the medium-term consequences of activities. An outcome of an innovation in a firm may be more highly skilled jobs. An outcome of a firm adopting a new technology may be a greater market share for that firm.
- **Impacts**: are the longer-term consequences of activities, linkages and outcomes. Wireless telephony is the result of many activities, linkages and outcomes. It has wide-ranging economic and social impacts such as increased connectedness.

The development of these indicators and their further elaboration is being done at Statistics Canada, in collaboration with other government departments and agencies, and a network of contractors.

Prior to the start of this work, the ongoing measurements of S&T activities were limited to the investment of money and human resources in research and development (R&D). For governments, there were also measures of related scientific activity (RSA) such as surveys and routine testing. These measures presented a limited picture of science and technology in Canada. More measures were needed to improve the picture.

Innovation makes firms competitive and we are continuing with our efforts to understand the characteristics of innovative and non-innovative firms, especially in the service sector that dominates the Canadian Economy. The capacity to innovate resides in people and measures are being developed of the characteristics of people in those industries that lead science and technology activity. In these same industries, measures are being made of the creation and the loss of jobs as part of understanding the impact of technological change.

The federal government is a principal player in science and technology in which it invests over five billion dollars each year. In the past, it has been possible to say only *how much* the federal government spends and *where* it spends it. Our report **Federal Scientific Activities, 1998 (Cat. No. 88-204)** first published socio-economic objectives indicators to show *what* the S&T money is spent on. As well as offering a basis for a public debate on the priorities of government spending, all of this information has been used to provide a context for performance reports of individual departments and agencies.

As of April 1999, the Program has been established as a part of Statistics Canada's Science, Innovation and Electronic Information Division.

The final version of the framework that guides the future elaboration of indicators was published in December, 1998 (**Science and Technology Activities and Impacts: A Framework for a Statistical Information System,** Cat. No. 88-522). The framework has given rise to **A Five-Year Strategic Plan for the Development of an Information System for Science and Technology** (Cat. No. 88-523).

It is now possible to report on the Canadian system on science and technology and show the role of the federal government in that system.

Our working papers and research papers are available at no cost on the Statistics Canada Internet site at http://www.statcan.ca/cgi-bin/downpub/research.cgi?subject=193.

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Access to financing capital by Canadian innovative biotechnology firms

Executive Summary

This paper uses data from the 2001 and 1999 Biotechnology Use and Development Surveys and the 1997 Biotechnology Firm Survey, to look into Canadian biotech firms' access to financing capital. Results show that over 70% of biotech firms that attempted to raise financing capital were successful.

The amount of capital raised reached $980 million in 2001. Funds were primarily sought for R&D activities. They came principally from Canadian venture capitalists. Harsher market conditions were the main reasons put forward by investors to limit or reject biotech firms' funding requests.

Highlights

- In 1999, 138 firms out of 178 that sought for financing capital were successful, resulting in a 78% success rate; the success rate was 71% in 2001;
- In 2001, 74 of the 134 successful firms or 55% reached their financing target;
- This high success rate extended across firm size, sector of activity and stage of development;
- The Human Health sector was the only sector that experienced a steady increase in the number of successful firms in the 1997-2001 period;
- Firms developing biotechnology applications in Aquaculture, Environment, BioInformatics and Natural Resources were the most likely to reach their financing target;
- In 2001, 116 out of 134 successful firms or 87%, raised funds to conduct R&D or to increase R&D capacity, making this the primary reason for which biotech firms raised capital in that year;
- Commercializing R&D projects and paying for regulatory/clinical expenses were also important reasons for seeking after funding;
- Repaying current investors was the least important reasons as only 12 firms out of 134 successful firms raised capital for this reason;
- The amount of capital raised by biotech firms was very volatile in the 1997-2001 period: from $467 million to $980 million in 2001, down from $2.15 billion in 1999;
- As a group, small firms with fewer than 50 employees raised more capital than any other firm size category: 71% in 1997; 79% in 1999 and 53% in 2001;

- Medium-sized firms were the only size group able to steadily and considerably increase the amount of fund raised, from $87 million in 1997 to $374 million in 2001, up from $160 million in 1999;

- Firms in the Human Health sector outperformed firms from other sector, except for 1999;

- Firms at the commercialization stage outperformed firms at other development stages, except for 1997;

- By far Canadian venture capital was biotech firms' primary source of funds;

- Large firms got funds mostly from conventional sources such as banks;

- Government funding to biotechnology was geared principally towards firms in Environment and in Agriculture;

- Harsher market conditions was the most important reason for which biotech firms' requests for capital was either limited or refused.

Introduction

Access to capital has been shown to contribute to rapid growth in biotech firms (Niosi 2000)[1]. However, accessing financing capital has been found by other studies to be a real challenge for technology-based firms (TBFs) in general, and in particular, for biotech firms (Baldwin, Gellatly and Gaudreault 2002; Glass, 2000; Bank of England, 2001). In this article, data from Statistics Canada's 1997 Biotechnology Firm Survey, and the 1999 and 2001 Biotechnology Utilization and Development surveys (BUDS) are used to investigate Canadian biotech firms' access to capital. The focus is on i) the amount of capital raised, ii) the number of firms that actually received funding and iii) the sources of capital. This contrasts with most studies on TBFs' financing issues which focus exclusively on either 1) the number of deals done in a given period, the amount of funds disbursed (McDonald and Associates, 2002; Baygan, 2003), or 2) the need to use equity financing instead of debt-financing (Baldwin et al. 2002). Additional issues investigated in this paper include, among other things, the reasons for raising capital and the reasons for which requests for capital were either denied or limited.

The paper is organized as follows: section 2 presents the data; section 3 deals with the number of biotech firms that successfully raised capital; section 4 looks into the reasons for which biotech firms raise capital; section 5 focuses on the amount of capital raised; section 6 looks into the sources of capital; and section 7 focuses on the reasons for which requests for capital were either limited or denied. Section 8 summarizes the findings.

II Data

Data for this study came from the 1997 Biotechnology Firm Survey, the 1999 Biotechnology Use and Development Survey (BUDS), and the 2001 BUDS[2]. All three survey questionnaires were designed by Statistics Canada in collaboration with Industry Canada, Agriculture and Agri-Food Canada, BioteCanada (in 1997), and business experts. The 1997 BUDS sample of respondents was based on a list of 475 firms and the response rate was 83%. Firms in the 1999 BUDS came from 1) a take-all list of firms and 2) a set of firms from a random sample from Statistics Canada's Business Registrar (BR). The questionnaire was sent to 3,377 firms and the response rate was 66%. As for the 2001 BUDS, a two-stage surveying methodology was used. The first stage, which in fact was a "pre-contact", was a short questionnaire designed to identify firms involved in biotechnology. It was sent to 11, 262 firms and had a response rate of 70%. The second stage questionnaire was sent to 900 firms and had a response rate of 84%.

Not-for-profit organizations, universities, government laboratories, hospitals, and contract research organizations (CRO's) were excluded from all three surveys. These entities, even though closely related to biotechnology firms through spin-off creation, or the provision of research services, are not part of the biotechnology survey target population which is made of firms currently using biotechnology. Also excluded from the 1999 and the 2001 BUDS were firms with

1. For more information on the growth in Canadian Biotech firms, see Traoré et al. (2003); Traoré (2003); McNiven, Raoub and Traoré (2003); Traoré and Rose (2003); Traoré (2004a); Traoré (2001); Arundel (1999); Arundel and Rose (1999); Rose 1999; McNiven (2001a; b); McNiven 2002; Byrd 2002.
2. The detailed survey methodology for the 1997 Biotechnology Firm Survey, the 1999 BUDS and the 2001 BUDS is available in Traoré (2004b).

less than 5 employees and spending less than $100,000 in R&D. This exclusion was intended to reduce respondents' burden. Based on past experience, this exclusion is not expected to affect the quality of the data as these firms contribute no more than 1% to biotechnology R&D expenditures, biotechnology revenues, the number of products in the pipeline, or to human resources, four key indicators of the intensity of biotechnology activities.

After accounting for non-responses and applying post-stratification techniques (Lohr 1999: 269-274), the number of the Canadian innovative biotech firms was estimated at 282 in 1997, 358 in 1999, and 375 in 2001. The following analysis is based on data provided by these firms.

III Number of firms successfully raising financing capital

3.1 Number of firms successfully raising capital by firm size

In 1997, 109 firms successfully raised funds. In both 1999 and 2001, half of biotech firms attempted to raise capital: 178 firms out of 358 in 1999 and 188 out of 375 firms in 2001. The success rate was 78% in 1999 as 138 of the 178 attempts resulted in some capital being raised; and 71% in 2001 when 134 firms out of 188 that attempted were successful in securing funds. Of the 134 successful firms in 2001, 74 or 55% did reach their financing target (Chart 1). In other words, 45% of the biotech firms failed to meet their financing targets. As will be shown below, harsher market conditions in 2001 was the main cause for which fund requests were either refused or limited.

Comparison by firm size categories shows that, in 1997, 89 of the 109 successful firms were small with 49 employees or fewer, 11 were medium-sized, 50 employees to 149 and 9 were large firms[3], 150 employees and over. The success rate was high for all firm size categories in 1999, ranging from 100% for large firms, 5 successes out of 5 attempts, to 63% for medium-sized firms, 15 successes out of 24 attempts. Small firms had a 79% success rate as 118 out of the 149 trials were successful. Success in 1999 extended to 2001 as both small and medium-sized firms enjoyed a 70% success rate: 109 successes out of the 156 attempts for small firms, and 16 out of the 23 attempts for medium-sized firms. All 9 large firms that attempted succeeded in raising some capital (Chart 1).

Medium-sized firms led the way in reaching financing target with 81% success rate or 13 out of 16 firms. Large firms stood at a 67% success rate, 6 out of 9 firms. One in every two small firms that raised capital did reach their financing target in 2001.

For all firm size categories, except for large firms for which the number of successful firms remained the same at 9 firms in both 1997 and 2001, the number of successful firms was on the rise in the 1997-2001 period: 89 to 109 for small firms and 11 to 16 for medium-sized firms. In the 1999-2001 period, small firms were the group experiencing a decrease in the number of successful firms: from 118 to 109 firms. For that period, the number of successful medium-sized firms remained steady, from 15 to 16 and that of large firms rose from 5 to 9.

3. The number of firms that attempted to raise capital in 1997 is not available as that question was not asked.

Chart 1: Number of biotech firms that attempted to raise capital by firm size, 1999, 2001

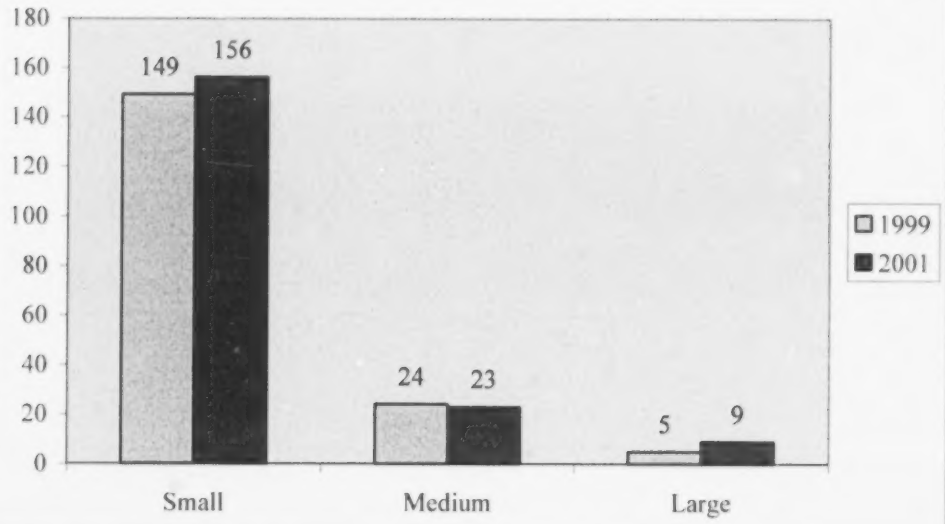
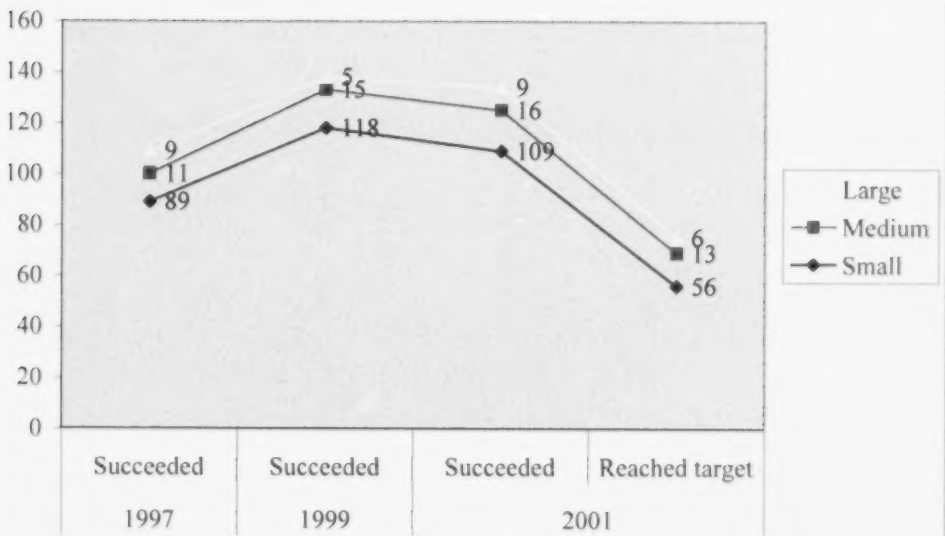


Chart 2: Number of biotech firms that succeeded in raising financing capital or reached financing target by firm size, 1997, 1999, 2001



3.2 Number of firms successfully raising capital by sector

As suggested by figures in Chart 3, overall, firms from all sectors have been successful in raising financing capital: in 1999, the success rate rank from 81% for firms in the Human Health sector to 65% for those in the Other sector. In 2001, it went from 46% for the Other sector to 75% in the Human Health sector.

It may also be noted from Chart 3 that overall, firms from the Human Health sector led the way. The number of firms from this sector that tried to raise financing capital rose by 21% in the 1999-2001 period, going from 104 to 126 firms. It was also the only sector where the number of firms that succeeded in raising financing capital rose steadily, going from 56 in 1997 to 94 in 2001, up from 84 in 1999. Conversely, for the same period, the Agriculture and Food Processing sector, after experiencing an increase in the number of successful firms from 25 to 34 in the 1997-1999 period, saw this number dropped to 29 in 2001. The Other sector saw a steady decrease from 28 in 1997 to 20 in 1999 and 11 in 2001 (Chart 4). However, firms from this sector had the highest likelihood to reach their financing targets, 8 out of 11 or 73%. Comparatively, 50 out of 94 firms, (53%) in the Human Health sector and 16 out of 19 firms, 55%, in the Agriculture and Food Processing sector were able to secure all the funds requested.

Chart 3: Number of biotech firms that attempted to raise capital by sector, 1999, 2001

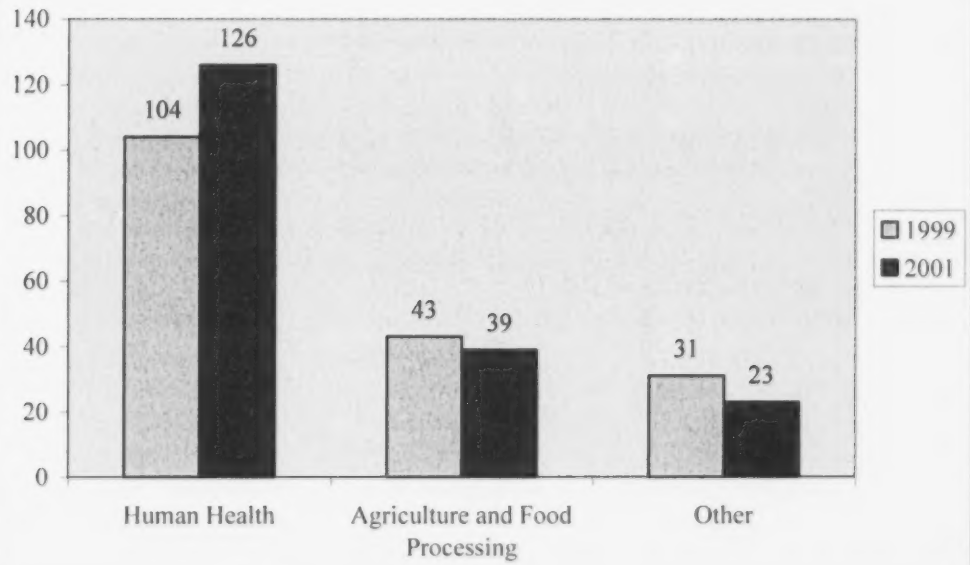
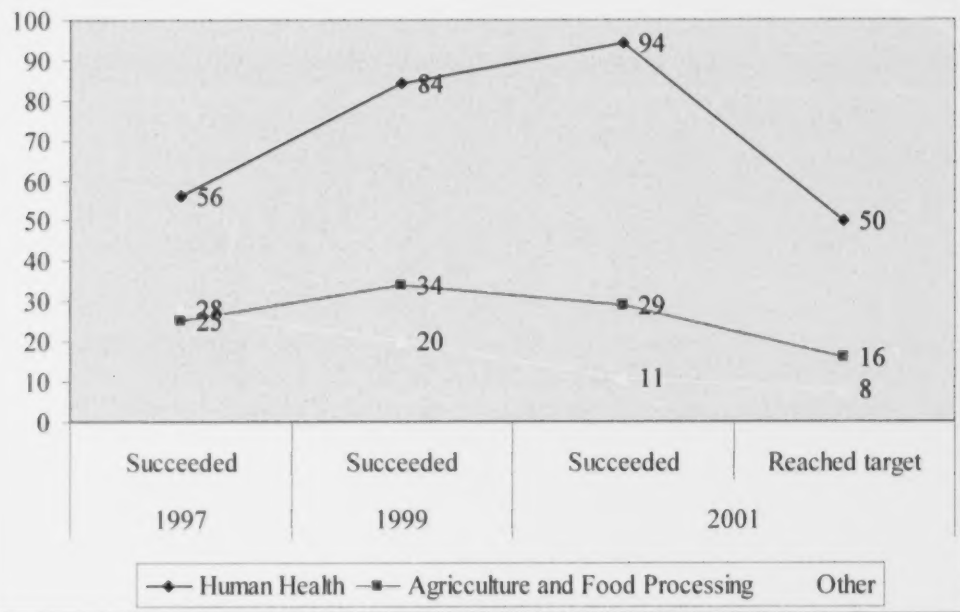


Chart 4: Number of biotech firms that succeeded in raising financing capital or reached financing target by sector, 1997, 1999, 2001



3.3 Number of firms successfully raising capital by stage of development

Of the 178 firms that attempted to raise capital in 1999, 82 were at the Commercialization[4] stage, 20 were in Product development/unconfined field trials, 27 were in Proof of concept/confined field trials, and 49 were at the conceptual or R&D stage. In 2001, these figures were respectively 63, 29, 38, and 57 (Chart 5). In both years, biotech firms at all development stages were successful in raising financing capital: 43 out of 49 for R&D firms or 87%; 18 out of 27, 67%, for Proof of concept/confined field trials firms; 20 out of 20 or 100% for firms in Product development/unconfined field trials and 57 out of 82 or 70% for Commercialization firms. In 2001, these figures were 45 out of 57 or 79% for R&D firms; 32 out of 38 or 84% for Proof of concept/confined field trials firms; 19 out of 29 or 66% for Product development/unconfined field trials firms; and 38 out of 63, 60%, for Commercialization firms (Chart 6).

Success in reaching financing target varied from 50% for Proof of concept/confined field trials firms, 16 out of 32 firms, to 68% for firms in Product development/unconfined field trials, 13 out of 19 firms. Firms at the R&D stage and the Commercialization stage reached their financing target in 53% and 57% of the cases, respectively (Chart 6).

4. Commercialization stage firms are all the firms with products either approved, in production or on the market.

Comparison of 1999 to 2001 shows that successful firms at the Proof of concept/confined field trials stage experienced the largest growth, going from 18 in 1999 up to 32 in 2001, a 78% increase in the period. This contrasts with the 33% decline in the number of successful firms at the Commercialization stage, from 57 down to 38 firms. The number of successful firms at the R&D stage and Product development/unconfined field trials remained steady, going from 43 to 44 firms and from 20 to 19 firms, respectively (Chart 6).

Chart 5: Number of biotech firms that attempted to raise financing capital by development stage, 1999, 2001

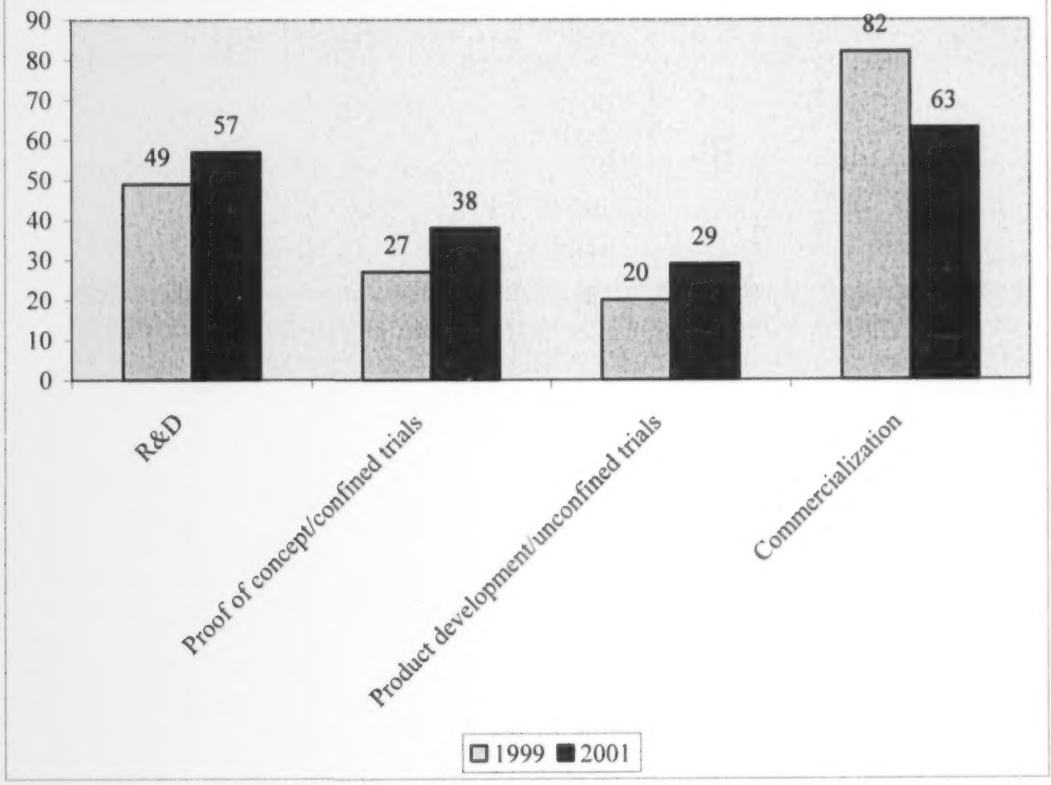
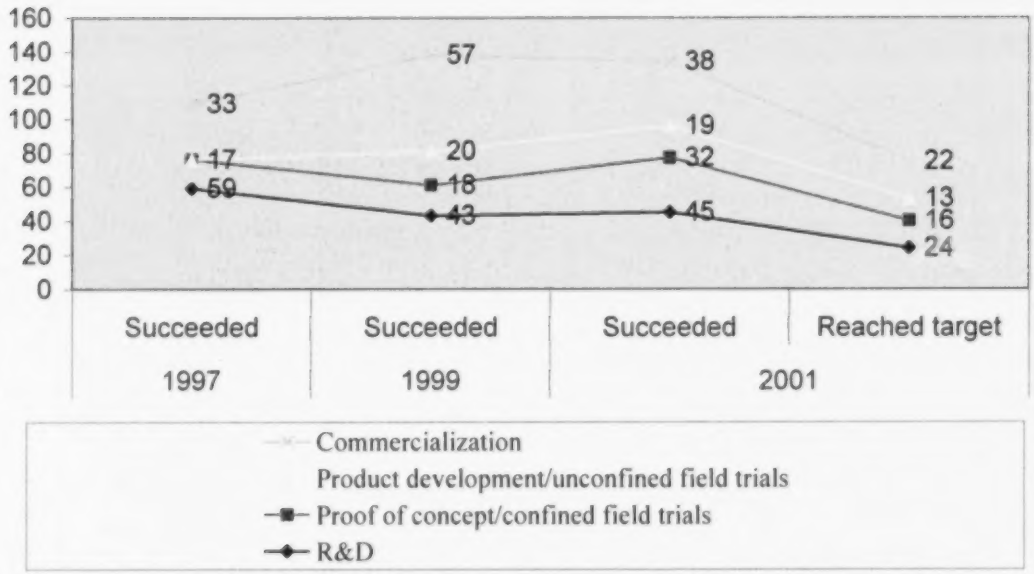


Chart 6: Number of biotech firms that succeeded in raising financing capital or reached their target by stage of developement 1997, 1999, 2001



3.4 Summary and comments

In both 1999 and 2001, biotech firms were successful in their attempts to raise capital: 78% success rate in 1999 and 71% in 2001. This holds true, irrespective of firm size, sector of activity and stage of development. Relative to the other firm categories, large firms led the way in both years as all their attempts resulted in a success. However, medium-sized had the highest likelihood to reach their financing targets. Success rate in reaching financing goals among small firms was one in two, the lowest among firm size categories. The Human Health sector was the only sector experiencing a steady increase in the number of firms successfully raising capital in the 1997-2001 period. However, firms from Aquaculture, Environment, Bioinformatics and Natural resources, i.e. the Other sector, were the most likely to reach their financing goals, 73% of the times. These results suggest that success in reaching financing target is intimately related to the origin of funds. In fact, as will be shown below, firms in the Other sector, two thirds of which are in natural resources and environment, get their funding primarily from government agencies, 37% and from collaborative partners and private placements, 28%. Government agencies are not profit-driven. They are therefore less risk averse and may be more willing to invest in biotech ventures. Collaborative partners may also have a higher risk threshold because of their close knowledge of the firm requesting funding. In contrast, venture capitalists, the primary source of funding for firms in the Human Health sector, are profit-driven and may require more stringent credit conditions. This may cause them to decrease, if not to limit the amount of fund requested by biotech firms. Hence, the higher percentage of firms in the other sector attaining their financing goals as compared to firms in the Human Health sector.

Among firms at all stages of development, those at the Product development/unconfined field trials stage were more likely to reach their funding goals. These firms get 45% of their funds from private placements and collaborative partners. Conversely, firms at other development stages are funded principally by private venture capital. This result seems to lend further support to the conclusion that source of funding and success in reaching financing target are intimately related.

IV Reasons for raising financing capital

4.1 Reasons for raising financing capital by firm size

Overall, undertaking R&D and expanding R&D capacity was the reason for which capital was raised in 2001. One hundred and sixteen (116) or 87% of the 134 firms that successfully raised funds in 2001 reported doing so for this reason (Table 1). The second most important reason was to commercialize current R&D projects, 60 firms. Other important reasons for raising capital, in decreasing order, were developing production/manufacturing capability, 52 firms; paying clinical/regulatory expenses, 40 firms; repaying current investors, at 13 firms; and other reasons, at 9 firms.

The predominance of expanding R&D capacity and conducting R&D as a reason to seek external funding holds true across all firm size categories. In fact, ninety three (93) small firms out of 109 successful small firms, 85%, raised capital to perform R&D or to expand their R&D capacities. Similarly, 14 out of 16 successful medium-sized firms, 87%, raised capital for that reason. So did all the 9 successful large firms. The second most important reason for small firms to raise capital was to commercialize current R&D projects. This was followed in decreasing order by developing production/manufacturing capacities, 42 firms; paying clinical/regulatory expenses, 33 firms; and repaying current investors, 12 firms (Table 1).

Table 1: Reasons for which biotech firms raised financing capital by firm size, 2001

	Firm size		
Reasons for raising capital	**Small (49 employees or fewer)**	**Medium and large (50 employees or over)**	**Total**
R&D/Expand R&D capacity	93	23	**116**
Repay current investors	12	x	**13**
Commercialize current R&D projects	50	10	**60**
Clinical/regulatory expenses	33	7	**40**
Develop production/ manufacturing capability	42	10	**52**
Other reasons	8	x	**9**

Source: Statistics Canada, Biotechnology Use and Development Survey, 2001

4.2 Reasons for raising financing capital by sector

Conducting R&D and expanding R&D capacities was the most important reason for raising capital in 2001 for firms of all sectors: 86 of the 94 successful firms from the Human Health sector, 91%, raised capital for this reason; so did 20 of the 29 successful firms, 69%, from Agriculture and Food Processing; and all the 11 firms from Aquaculture, Natural resources and BioInformatics, i.e. the Other Sector (Table 2).

Commercializing current R&D was the second reason in importance for Human Health sector firms, 41 firms, while developing production and manufacturing capabilities came third. Paying clinical and regulatory expenses closely followed with 30 firms. For firms in the Agriculture and Food Processing sector, developing production and manufacturing capacities and commercializing current R&D were equally important and both placed second at 13 firms. As for firms in Aquaculture, Natural resources, Environment and Bio-Informatics, developing production and manufacturing capacities was the second most important reason for raising capital, 8 firms, followed by commercializing current R&D project, 6 firms. Paying current investors was not a primary reason for raising capital for firms in any sector (Table 2).

Table 2: Reasons for which biotech firms raised financing capital by sector of activity, 2001

	Sector			
Reasons for raising capital	**Human health**	**Agriculture and food processing**	**Other**	**Total**
R&D/Expand R&D capacity	86	20	11	**116**
Repay current investors	10	x	x	**13**
Commercialize current R&D projects	41	13	6	**60**
Clinical/regulatory expenses	30	x	x	**40**
Develop production/ manufacturing capability	31	13	8	**52**
Other reasons	6	x	x	**9**

Source: Statistics Canada, Biotechnology Use and Development Survey, 2001

4.3 Reasons for raising financing capital by stage of development

For firms at all stages of development, conducting R&D and expanding R&D capabilities was the most important reason for raising capital. This was followed in importance by commercializing current R&D projects except for firms at the Proof of concept/confined field trials stage for which paying clinical/regulatory expenses was the second most important reason for raising capital. The third reason in importance for raising capital was developing manufacturing and production capacities for firms at the Commercialization stage while this position was shared by paying clinical/regulatory expenses and developing production/manufacturing capacities for firms at both the R&D and Product development/unconfined field trial stages (Table 3).

Table 3: Reasons for which biotech firms raised financing capital by stage of development, 2001

	Stage of development				
Reasons for raising capital	**R&D**	**Proof of concept/confined field trials**	**Product development/confined field trials**	**Commercial-ization**	**Total**
R&D/Expand R&D capacity	39	29	16	32	**116**
Repay current investors	x	5	x	7	**13**
Commercialize current R&D projects	12	13	10	25	**60**
Clinical/regulatory expenses	8	17	9	6	**40**
Develop production/ manufacturing capability	8	11	9	24	**52**
Other reasons	6	0	x	x	**9**

Source: Statistics Canada, Biotechnology Use and Development Survey, 2001

4.4 Summary and comments

By and large, capital was raised for R&D related activities such as conducting R&D, expanding R&D capacities, commercializing current R&D projects, or paying for clinical and regulatory expenses. This holds true irrespective of firm size, sector of activity and development stage. Repaying current investors was the least important reason in 2001. This underscores the research intensive nature of biotechnology and suggests that, for the time being, biotech firms' managers are not under pressure to pay investors. A possible reason to the latter may be that no more than a quarter of biotech firms are public and as will be shown below, they mostly get funding from venture capitalists, private placements and collaborative partners, and government sources for environment and agriculture firms. All these three sources have a medium to long term investment horizon.

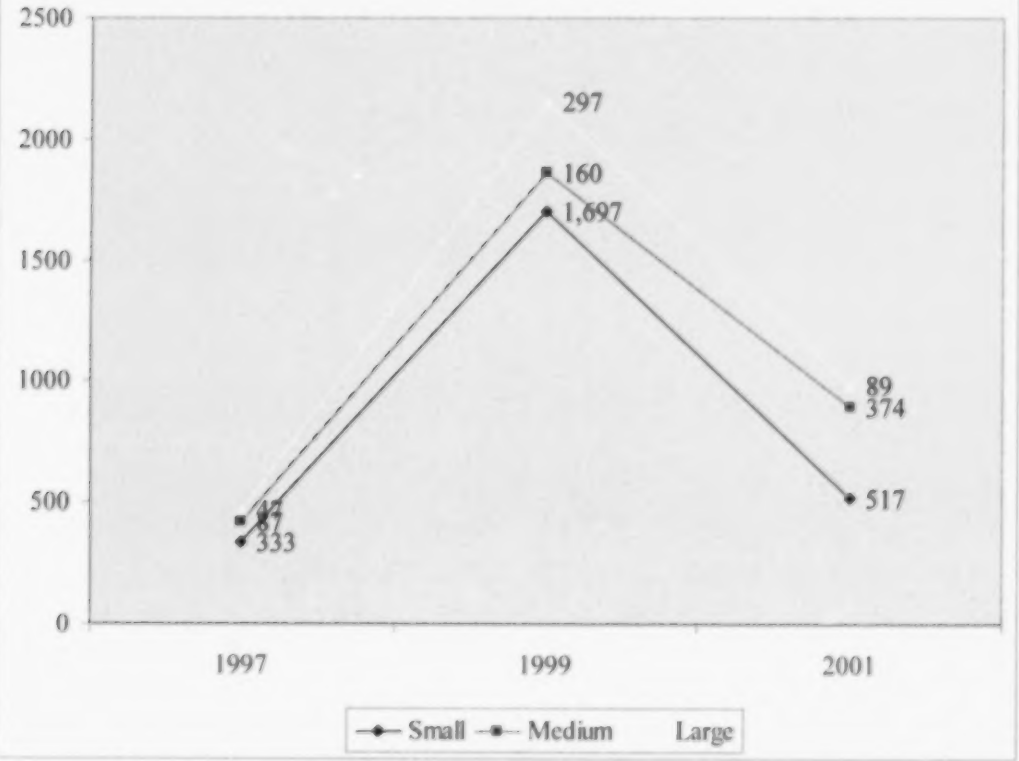
V Amount of capital raised

5.1 Amount of capital raised by firm size

In 2001, biotech firms raised $980 million in financing capital. This was far less than the $2.15 billion raised in 1999. However, it was almost double the amount raised four years earlier, $467 million. This resulted from all firm categories having been able to secure more funds from investors in the 1997-2001 period: small firms raised $333 million in 1997 and $517 million in 2001, a 55% increase. Likewise, medium-sized firms raised $87 million in 1997 and $374 million in 2001, a 330% increase over the period. Funds raised by large firms went from $47 million to $89 million in the 1997-2001 period, an 89% increase (Chart 7).

If all firm size categories were able to considerably raise more capital in 1999 than in 1997, from $333 million in 1997 to $1.7 billion in 1999 for small firms; $87 million to $160 million for medium-sized firms and from $47 million to $297 million for large firms, only medium-sized firms were able to sustain this trend in the 1999-2001 period. They raised $374 million in 2001 as compared to $160 million in 1999, a 134% increase. In contrast, small firms experienced a decrease in the amount of capital raised, from $1.7 billion to $517 million, a 69% decrease. Likewise, large firms saw their capital amount raised fall from $297 million in 1999 to $89 million in 2001, a 70% decrease. Thus, despites small firms being the group raising the largest amount of capital, 71% in 1997, 79% in 1999 and 53% in 2001, medium-sized firms experienced the highest growth in funds collected to finance biotechnology activities in the 1997-2001 period (Chart 7).

Chart 7: Amount of capital raised by biotech firms by firm size 1997, 1999, 2001

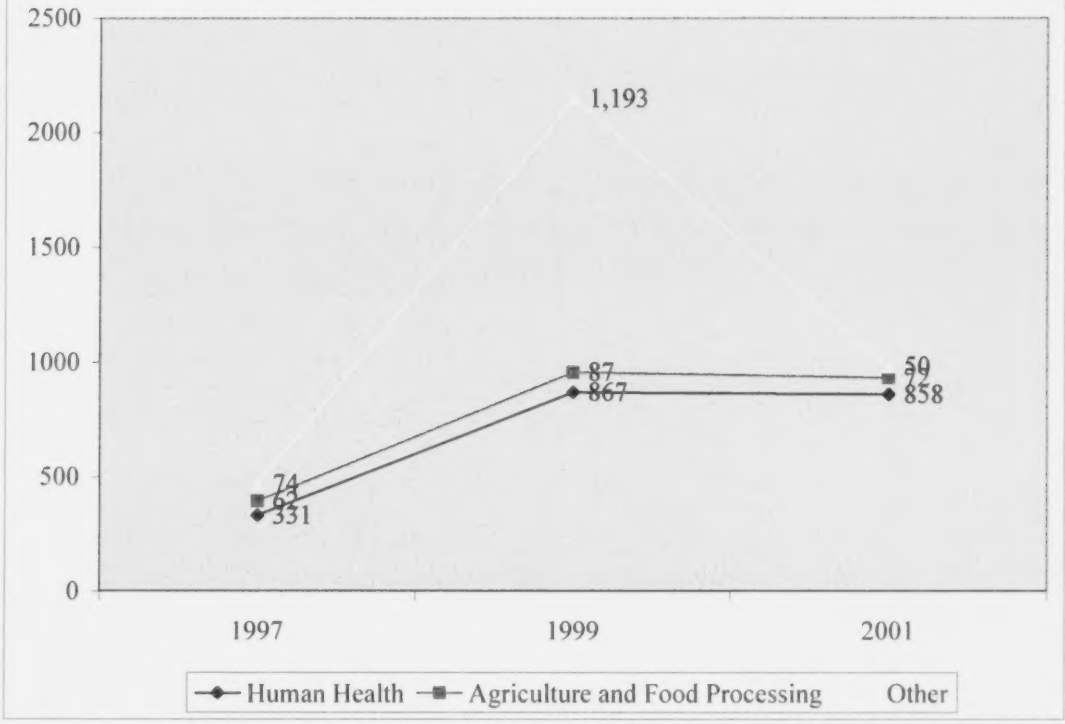


5.2 Amount of capital raised by sector

Except for Environment, Bio-informatics and Aquaculture, i.e. the Other sector, all sectors have raised more capital in 2001 than 4 years earlier: $331 million for the Human Health sector in 1997 as compared to $858 million in 2001; $62 million for the Agriculture and Food processing sector in 1997 and $72 million in 2001 (Chart 8). In contrast, firms in Environment, BioInformatics and Aquaculture raised 48% less capital, $50 million in 2001 as compared to $74 million in 1997. This contrasts with their performance in the 1997-1999 period where they increased their amount of capital raised by 1,512%, from $74 million in 1997 to $1.2 billion in 1999. Relatively, firms from the Human Health and the Agriculture and Food Processing sectors did not experience such a growth, even though both sectors were able to secure more funds from investors during that period: $867 million in 1997 against $331 million in 1999 for the Human Health sector and $87 million in 1997 against $62 million in 1999 for the Agriculture and Food Processing sector.

Overall, firms in the Human Health sector were very successful in raising financing capital than firms in the other sectors. As a group, in 1997, they raised $332 million, 71% of all the funds raised that year, more than 5 times than firms in the Agriculture and Food Processing sector and 4.5 times more than firms in the Other sector. In 2001, they accounted for $858 million of the $980 million raised, i.e. 89% of all funds raised. Even though all the sectors experienced a fall in their amounts of fund raised in the 1999-2001 period, firms in the Human Health sector had the slightest decrease, from $867 million to $858 million, as compared to the Other sector whose funds dropped by $1.1 billion, a 2,286% decrease, and the Agriculture and Food processing which experienced a 17% decrease from $87 million to $72 million (Chart 8).

Chart 8: Amount of capital raised by biotech firms by sector 1997, 1999, 2001



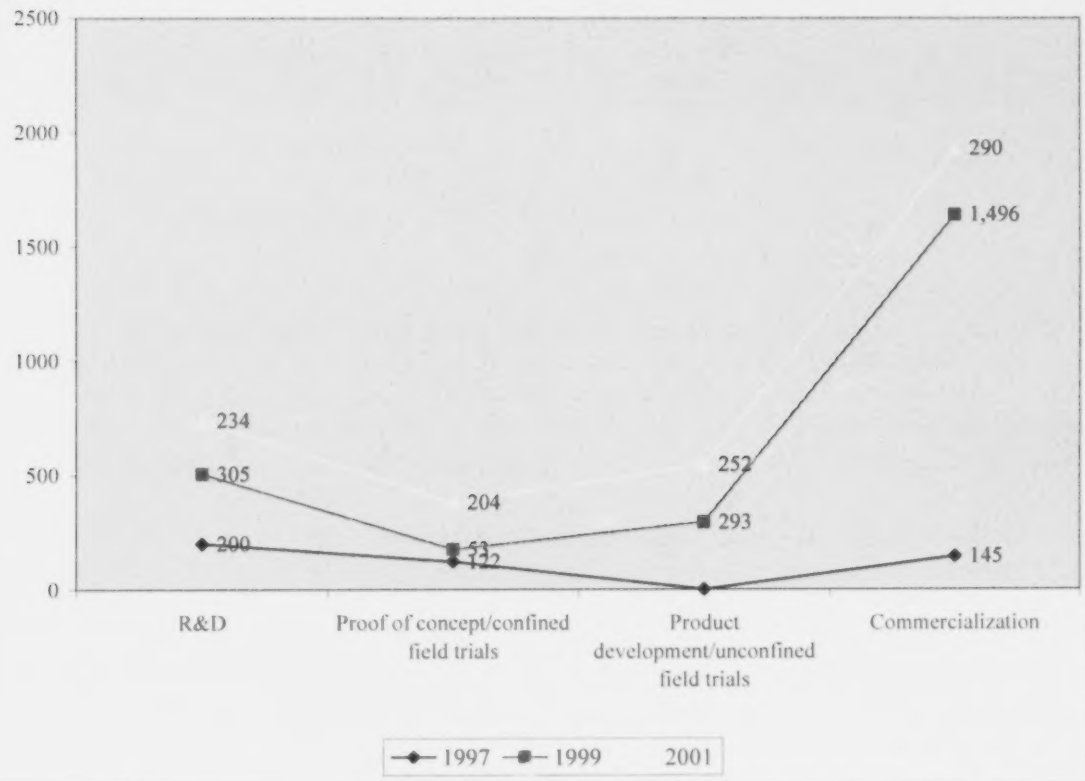
5.3 Amount of capital raised by stage of development

In 1997, firms at the R&D stage raised $200 million, i.e. 43% of the $467 million total capital raised. Comparatively, Proof of concept/confined field trials and Commercialization firms raised respectively $122 million and $145 million, i.e. 26% and 31% of all funds in 1997. Of the $2.15 billion raised in 1999, firms at the Commercialization stage raised $1.5 billion, 5 times more than firms at both the R&D and the Product development/unconfined field trials stages, and 28 times more than those in Proof of concept/confined field trials. In 2001, of the $980 million raised, they raised $290 million, more than firms at any other development stage (Chart 9).

Over the 1997-2001 period, firms at all development stages were successful in increasing the amount of capital raised: $200 to $235 million, 17% increase for R&D stage firms; $122 to $456 million or 237% for firms at the pre-clinical and Product development/unconfined field trials stages combined; and 100% for firms at the Commercialization stage. This contrasts with the 1999-2001 period. Except for firms in Proof of concept/confined field trials which quadrupled

their amount of capital collected from $53 to $204 million, all firm categories experienced a drop in their funds. Firms at the Commercialization stage raised $290 million in 2001, down from $1.5 billion in 1999. Their share in total funds raised was 30% in 2001, down from 70% in 1999. Firms at the R&D and the Product development/unconfined field trials stages experienced much smaller declines, 23%, and 14%, respectively.

Chart 9: Amount of capital raised by biotech firms by development stage 1997, 1999, 2001



5.4 Summary and comments

Despites a sharp decrease in the amount of capital raised in the 1999-2001, biotech firms almost doubled the amount of funds they secured from investors in the 1997-2001 period, $980 million from $467 million. In contrast to other firm size categories that experienced a decrease in the amount of funds collected in the 1999-2001 period, medium-sized firms were able to steadily collect more funds in both the 1997-1999 and 1999-2001 period. In 2001, on average, medium firms had up to 82 products in their portfolio. Comparatively, small firms had 38 products and large firms, 61. The same trend was true in 1999 when medium-sized firms held an average portfolio of 112 products against 41 for small firms and 18 for large firms. In addition, as found

by McNiven, Raoub and Traoré (2003), in the 1999-2001 period, up to 15% of biotech firms have grown from small to medium-sized firms, suggesting a maturing process. In this process, medium-sized firms have established a credible biotech track by which potential investors may assess their viability as economic units. All these factors may explain their success in raising funds and attaining their financing goals.

Firms from the Human health sector outperformed firms from all the other sectors as not only they raised the largest share of funds but they also experienced the slightest decrease in the 1999-2001, a period of "hardship" for firms of all sectors. Investors may easily assess the financial and economic viability of health related products/processes. For example, a Human Health firm developing a diagnostic kit for diabetes has a pretty good idea of both the size of the market and the potential commercial success of its kit. Indeed, the extent to which this disease affects the general population is known to all, including investors. Consequently, it will have less problem convincing potential investors to lend her the necessary fund to finance its activities. The same will not necessary hold true for a firm in Environment or Aquaculture where the market for a given product is unknown and its commercial success much more uncertain. This may explain the greater success rate enjoyed by firms from the Human Health sector in collecting larger amount of funds, comparative to firms from other sectors.

Except for 1999, firms at the R&D stage collected more funds than firms at any other development stage. This lends further support to previous results about the research intensive nature of biotech firms.

VI Sources of capital

6.0 General

As shown by figures in Table 4, venture capital remains the most important source of financing capital for biotech firms. In the 1999-2001 period, the share of this source in total capital rose from 30% to 43%. As well, the number of firms receiving funds went from 53 to 123 firms, a 132% increase. Private placements and collaborative partners were the second most important source of capital. This source provided for 23% of funds in both 1999 and 2001 and gave funds to 53 firms and 59 firms in each of these years, respectively.

Even though their share in total capital dropped from 27% in 1999 to 15% in 2001, angel investors, family and friends provided funds to more firms in 2001, 56 firms, than in 1999, 51 firms. This result lends support to findings in similar studies that this source plays an important role for TBF's such as biotech firms, i.e. filling the capital gap left by other investors, principally venture capitalists (Glass, 2000).

Government sources' share in total capital went from 7% in 1999 to 13% in 2001. Even more importantly, the number of firms obtaining funds grew by 106%, going from 29 firms to 60 firms, suggesting an increasing government involvement in supporting biotechnology firms over the 1999-2001 period.

Conventional sources such as banks provided 7% of total capital in both years, making them a secondary source of funds for biotech firms (Table 4). They funded 31 firms in 1999 and 27 in 2001, a 13% decrease. Public offerings were a very minor source of funds, providing only 2% of all the funds in 1999. Only 8 firms benefited from these funds.

Table 4: Percentage of capital raised from each source and number of firms that received funds from each source, 1999, 2001

Sources of financing capital	1999		2001	
	% of capital raised	Number of firms	% of capital raised	Number of firms
Angel investors/family/friends	27	51	15	56
Government loans/grants/incentives	7	29	13	60
Venture capital funds	30	53	43	123
Conventional sources (e.g. Banks)	7	31	7	27
Initial public offerings (IPO)	2	8	...	...
Collaborative alliance, Partners and private placements	23	53	23	59

Source: Statistics Canada, 1999 and 2001 Biotechnology Use and Development Surveys (BUDS)
Note:
... Not available

6.1 Sources of capital by firm size

As shown in Table 5, when venture capital is divided into Canadian based venture capital and American venture capital, the former provided the largest share of funds to small and medium-sized firms, 37% and 46%, respectively. Strategic partners and private placements was the second source in importance for these two firm categories, providing 22% of funds to small firms and 32% of funds to medium-sized firms. The third source of funds for small firms was Angel Investors/Family/Friends, 16% of funds. This rank belonged to American venture capital for medium-sized firms, 8% of funds. Together, conventional and Government sources provided 54% of large firms' funding. Strategic partners and private placements provided 15% of their funds (Table 5)[5].

5. Large firms obtained no funding from American venture capital and only 14% of their funds came from Canadian based venture capital.

Table 5: The three most important sources of capital by firm size, 2001

	Most important source	Second most important source	Third most important source
Firm size			
Small (49 employees or less)	Canadian venture capital **(37%)**[a]	Private placements and collaborative partners **(22%)**	Angel investors/Family **(16%)**
Medium (50 to 149 employees)	Canadian venture capital **(46%)**	Private placements and collaborative partners **(32%)**	American venture capital **(8%)**
Large (150 employees or over)	Conventional sources (e.g. banks) **(29%)**	Government **(25%)**	Private placements and collaborative partners **(15%)**

Source: Statistics Canada, Biotechnology Use and Development Survey, 2001

[a] Shares of capital from each source are in parentheses

6.2 Sources of capital by sector

In 2001, the primary source of funds for firms in the Human Health sector was the Canadian venture capital which provide 42% of all capital raised by the sector. Strategic partners and private placements came second, at 20% and Angel investors/family/friends were third at 18%. The Agriculture sector got its funds primarily from Strategic partners and private placements, 41%. Government sources provided 18% of their funds, placing these as the second most important source of capital. The Canadian venture capital was the third most important capital source. This source provided the largest share of fund to the Food Processing sector, 34%, followed by strategic partners and private placements at 22% and conventional sources at 19%. Government was the primarily source of funds for the Environment sector, followed by strategic partners and private placements, at 28%, and the Canadian venture capital, at 22%. Firms in the Environment sector also had a large share of their funding coming from strategic partners and private placements, 28%, even though funds from Government sources provided the bulk of their financing capital, 37%. They also obtained 22% of their funds from Canadian venture capitalists (Table 6).

Table 6: The three most important sources of capital by sector, 2001

	Most important source	Second most important source	Third most important source
Selected sectors			
Human health	Canadian venture capital **(42%)**[a]	Private placements and collaborative partners **(20%)**	Angel investors/Family **(18%)**
Agriculture	Private placements and collaborative partners **(41%)**	Government **(18%)**	Canadian venture capital **(17%)**
Food processing	Canadian venture capital **(34%)**	Private placements and collaborative partners **(22%)**	Conventional sources **(19%)**
Environment	Government **(37%)**	Private placements and collaborative partners **(28%)**	Canadian venture capital **(22%)**

Source: Statistics Canada, Biotechnology Use and Development Survey, 2001
[a] Shares of capital from each source are in parentheses

6.3 Sources of capital by stage of development

Firms at the R&D stage got their funds principally from Canadian venture capitalists, 40%, Angel Investors/family/friends, 22% and private placements and strategic partners, 14%. Firms in Proof of concept/confined field trials got their financing from Canadian venture capital, 43%, private placements and strategic partners, 17% and American venture capital, 16%. Private placements and strategic partners was the main source of funds for Product development/unconfined field trials firms, 45%, followed by Canadian venture capital, 31%, and Angel investors/family/friends, 8%. Canadian venture capital provided 28% of the funds to commercialization stage firms, private placements and strategic partners, 26%, and Angel investors/family/friends, 18% (Table 7).

Table 7: The three most important sources of capital by stage of development, 2001

	Most important source	Second most important source	Third most important source
Stage of development			
R&D	Canadian venture capital **(40%)**[a]	Angel investors/Family **(22%)**	Private placements and collaborative partners **(14%)**
Proof of concept/confined field trials	Canadian venture capital **(43%)**	Private placements and collaborative partners **(17%)**	American venture capital **(16%)**
Product development/unconfined field trials	Private placements and collaborative partners **(45%)**	Canadian venture capital **(31%)**	Angel investors/Family **(8%)**
Commercialization	Canadian venture capital **(28%)**	Private placements and collaborative partners **(26%)**	Angel investors/Family **(18%)**

Source: Statistics Canada, Biotechnology Use and Development Survey, 2001
[a] Shares of capital from each source are in parentheses

6.4 Summary and comments

Overall, Canadian innovative biotech firms got their financing from three main sources: Canadian venture capital, private placements and strategic partners, and Angel investors, friends and family members. American venture capital was an important source of capital for Proof of concept/confined field trials firms. Private placements and strategic partners provided financing to all types of firms, with a preference for Product development/unconfined field trials stage firms.

The Canadian venture capital was important for Human Health and Food processing firms. Strategic partners and private placements were also important as they were the primary source of funds for agricultural firms and rank second in importance for Human Health, Food processing and Environment.

Also worth noting is that even though Canadian venture capital is a very important source of funding, biotech firms tend to have multi-funding sources. This is true irrespective of their size, their sector of activity and their stage of development. This tends to suggest a greater risk dispersion strategy through a balanced portfolio of funding sources, the end result being avoiding to be at the mercy of any single investor.

VII Reasons for limiting or refusing requests for capital

7.0 General

In 1999, 40 firms or 22% of firms that attempted to raise capital failed. In 2001, 54 out of 188 attempts or 29% resulted in a failure. Sixty other firms (60) could not reach their target in 2001. As shown in Table 8, this situation was due, in 78 cases, to the unavailability of financing capital because of market conditions. In 43 cases, lenders needed further product development or proof of concept and in 42 other cases, biotechnology product/process was deemed not sufficiently developed to warrant financing. Other important reasons why financing was denied or limited related to lenders not funding development projects, 28 cases. Other reasons such as GMO issue being of a concern, lack of strategic partners, lender's lack of expertise to assess biotechnology, lack of benchmark against which to assess new biotech market success, accounted for 26 refusals. Limited biotechnology product line or portfolio in scope and insufficient specific management skills/expertise were the reasons why financing was denied to only 13 and 12 firms, respectively. Thus, only 11% of the refusals or limiting of credit were based on these factors. The sustainability of any competitive edge and consequently, the survival of biotech firms as economic units, are strictly dependent on its strengths, namely, i) a healthy portfolio or pipeline and ii) the expertise and skills of the managers or owners (Bachher and Guild, 1996; Villalonga, 1999). Surprisingly, these factors are given very little weight in assessing biotech firms' creditworthiness. Two possible reasons may explain this finding. First, investors may have correctly assess market conditions, the expertise and management skills of the owners and managers, and the level of development product but are not willing to take risk with development projects. Second, many biotech do not earn any revenues, a key performance and creditworthiness indicator for most investors. In addition, most of their assets are in the form of patents and licenses, i.e. intangible assets that may be hard for investors to value.

7.1 Reasons for lenders limiting or refusing requests for capital by firm size

Small firms experienced the largest number of capital request refusals or denials. In fact, they were denied funding for all sort of reasons. However, three main reasons stood out: 68 of the 78 firms that were denied funding because of market conditions were small firms. This figure was 37 out of 43 for the requirement of further product development or proof of concept, and 37 out of 42 for biotechnology product/process not sufficiently developed. All the firms that were denied funding or which funding requests were limited because of limited biotechnology product portfolio and insufficient specific management skills/expertise were small firms (Table 8).

Table 8: Reasons for which biotech firms' requests for capital were denied by firm size, 2001

	Firm size		
Reasons	**Small (49 employees or fewer)**	**Other (Medium and large: 50 employees or over)**	**Total**
Biotechnology product/process not sufficiently developed	37	5	**42**
Biotechnology product line or portfolio limited in scope	13	0	**13**
Insufficient specific management skills/expertise	12	0	**12**
Capital not available due to market conditions	68	8	**78**
Further product development or proof of concept required	37	6	**43**
Lender does not fund development project	25	x	**28**
Other reason	24	x	**26**

Source: Statistics Canada, Biotechnology Use and Development Survey, 2001

7.2 Reasons for lenders limiting or refusing requests for capital by sector

Firms from the Human Health sector saw their requests for funding turned down principally because of harsher market conditions, 53 out of 94 successful firms or 56%. The second reason put forward to refuse or limit their capital requests was that further product development or proof of concept was required, 28 firms. This was closely followed by the fact that biotechnology products/processes were not sufficiently developed, 25 firms, and the fact that lenders did not fund development project, 17 firms. Other reasons accounted for 17 refusals (Table 9).

The two most important reasons for refusing capital to firms in Agriculture and Food Processing and the Other sector, i.e. Natural resources, Aquaculture, Environment, BioInformatics were the lack of funding due to market conditions and not sufficiently developed biotechnology products/processes (Table 9).

Table 9: Reasons for which biotech firms' requests for capital were denied by sector of activity, 2001

	Sector			
Reasons	**Human health**	**Agriculture and food processing**	**Other**	**Total**
Biotechnology product/process not sufficiently developed	25	10	7	**42**
Biotechnology product line or portfolio limited in scope	6	x	x	**13**
Insufficient specific management skills/expertise	9	x	x	**12**
Capital not available due to market conditions	53	19	6	**78**
Further product development or proof of concept required	28	x	x	**43**
Lender does not fund development project	17	x	x	**28**
Other reason	17	x	x	**26**

Source: Statistics Canada, Biotechnology Use and Development Survey, 2001

7.3 Reasons for lenders limiting or refusing requests for capital by stage of development

Irrespective of the stage of development, harsher market conditions was the primary reason for capital requests being limited or refused. For firms at the R&D stage, the second most important reason was biotechnology products/processes not being sufficiently developed, 13 firms. This was followed by the need for further product development or proof of concept, 8 firms. As for firms at the proof of concept/confined field trials stage, the other two most important reasons for which they could not get financing were the need to further develop their products/processes and the fact that their products/processes were not sufficiently developed, 8 firms. The second and third reasons for refusing funding to firms at the Product development/unconfined field trials and those at the Commercialization stages were the need for further product development or proof of concept and the fact that the lender does fund development projects (Table 10).

Table 10: Reasons for which biotech firms' requests for capital were denied by stage of development, 2001

	Stage of development				
Reasons	**R&D**	**Proof of concept/ confined field trials**	**Development/ unconfined field trials**	**Commercial-ization**	**Total**
Biotechnology product/process not sufficiently developed	13	8	8	8	**42**
Biotechnology product line or portfolio limited in scope	x	x	6	6	**13**
Insufficient specific management skills/expertise	x	x	x	6	**12**
Capital not available due to market conditions	24	18	10	26	**78**
Further product development or proof of concept required	8	8	9	19	**43**
Lender does not fund development project	x	x	9	11	**28**
Other reason	8	x	x	10	**26**

Source: Statistics Canada, Biotechnology Use and Development Survey, 2001

7.4 Summary and comments

Irrespective of size, sector of activity or stage of development, biotech firms' requests for capital were generally limited or refused for three main reasons: unavailability of funds due to market conditions, the need for further product development or proof of concept and biotechnology product/process not being sufficiently develop. Small firms, firms in the Human Health sector, and those at the R&D or Commercialization were the most affected primarily by these funding limitations or refusals. Reasons for that situation range for investors' unwillingness to invest in development ventures, lack of hard assets to serve as collateral for investors, concern about some of biotech products such as GMO; and investors' inability to fully assess biotech products' future market success due to the benchmark products.

VIII Conclusion: Summary of the findings

This paper looks into Canadian biotech firms' access to financing capital. In contrast to most studies on access to funds by technology-based firms (TBFs) such as biotech firms, this study looks into access to capital in terms of the number of firms actually raising capital, the amount of capital raised, the sources of capital, the reasons for funding requests to be either limited or denied, and the reasons for raising capital. To this end, data from the 1997 Biotechnology Firm Survey, the 1999 and the 2001 Biotechnology Use and Development Surveys were used.

Overall, biotech firms were successful in their attempts to raise financing capital. For one, 138 of the 178 firms (78%) that tried in 1999, succeeded in raising capital. Likewise, 71% or 134 out of 188 firms that attempted were able to secure funds in 2001. Of these 134 successful firms, 74 or 55% reached their financing target. Capital was raised mainly to conduct R&D and expand R&D capacities. Other important reasons include commercializing R&D projects and paying for clinical/regulatory expenses. Repaying current investors was the least important reason for raising capital.

Biotech firms' success in raising capital is also reflected by the amount of funds secured from investors: despites a sharp decrease in the 1999-2001 period, they almost doubled the amount of funds raised in the 1997-2001, from $467 million in 1997 to $980 million in 2001. As a group, small firms with fewer than 50 employees collected the largest share of funds in 1997, 71%; in 1999, 78% and in 2001, 53%. However, medium-sized firms were the only firm category that steadily increased the amount of capital raised in the 1997-2001 period, from $87 million in 1997 to $374 million in 2001, up from $160 million in 1999. The Human Health sector outperformed the other sectors as firms from this sector collected the largest amount of funds in the 1997-2001 period: 71% in 1997; 40% in 1999 and nearly 88% in 2001. Commercialization stage firms secured more funds from investors in both 1999, $1.5 billion out of $2.15 billion and in 2001, $290 million out of $980 million.

These funds originated primarily from venture capitalists. Private placements and strategic partners, and Angel investors follow in second and third place, respectively. Size comparison shows some differences among firm sizes. While small and medium sized-firms get their funding from Canadian venture capital, large firms relied on conventional sources such as banks as a primary source of funds. Government's funding is primarily geared toward firms in Environment, Agriculture and large firms. The Human Health sector and Food Processing relied on the Canadian venture capital for funding. Except for firms at the Product development/unconfined field trials which got most of their financing capital from private placements and strategic partners, firms from the other stages of development get funding mostly from the Canadian venture capital.

Irrespective of size, sector of activity or stage of development, biotech firms' requests for funding was either limited or refused because of three main reasons: lack of funds due to harsher market conditions, need for further proof of concept or product/develop and the need for developing further products/process for which funds were sought.

References

Arundel, Anthony and Antoine Rose, 1999. The diffusion of environmental biotechnology in Canada: adoption strategies and cost offsets. Technovation 19:551-560.

Arundel, Anthony, 1999. Diffusion of Biotechnology in Canada: Results from the Survey of Biotechnology Use in Canadian Industries – 1996, Cat. No. 88F0017XIE, Research paper No. 06, Science, Innovation and Electronic Information Division (SIEID), Ottawa, Statistics Canada.

Bachher, S. Jagdeep and Paul D. Guild, 1996. Financing early stage technology base companies: investment criteria used by investors. Frontiers of Entrepreneurship Research, 1996 Edition.

Baldwin, R. John, Guy Gellatly and Valérie Gaudreault, 2002. Financing innovation in new small firms: new evidence from Canada, Cat. No. 11F0019MIE – No. 190, Micro-Economic Analysis Division, Ottawa, Statistics Canada.

Bank of England, 2001. The financing of technology-based small firms: a review of the literature.

Baygan, Günseli, 2003. Venture Capital Policy Review: Canada. STI working paper 2003/4, Industry Issues, OECD, Directorate for Science, Technology and Industry.

Byrd, Craig, 2002. Results from the Biotechnology Use and Development Survey – 1999: Profile of Spin-off Firms in the Biotechnology Sector, Cat. No. 88F0006XIE2002004, SIEID, Ottawa, Statistics Canada.

Glass, J. Alexander, 2000. Finding capital for technology start-ups. The Industrial Physicist, October.

Lohr, L. Sharon, 1999. Sampling: Design and Analysis. Duxbury Press, Albany, New York, U.S.A.

McDonald & Associates Limited, 2002. The venture capital Industry in 2001: An overview.

McNiven, Chuck, Lara Raoub, Namatié Traoré. 2003. Features of Canadian biotechnology innovative firms: Results from the biotechnology use and development survey – 2001, Cat. No. 88F0006XIE2003005, Ottawa, Statistics Canada.

McNiven, Chuck, 2001a. Biotechnology Use and Development – 1999, Cat. No. 88F0006XIE, No. 7, Science, Innovation and Electronic Information Division (SIEID), Ottawa, Statistics Canada.

McNiven, Chuck, 2001b. Practices and Activities of Canadian Biotechnology Firms: Results from the Biotechnology Use and Development Survey – 1999. Cat. No. 88F0006XIE, No. 11, Science, Innovation and Electronic Information Division (SIEID), Ottawa, Statistics Canada.

McNiven, Chuck, 2002. Use of Biotechnology in the Canadian Industrial Sector: Results from the Biotechnology Use and Development Survey – 1999, Cat. No. 88F0006XIE, Working paper No. 03, SIEID, Ottawa, Statistics Canada.

Niosi, Jorge, 2000. Explaining rapid growth in Canadian biotechnology firms, Cat. No. 88F0017XIE, Research Paper No. 8, SIEID, Ottawa, Statistics Canada.

Rose, Antoine, 1998. Biotechnology Use by Canadian Industry – 1996, Cat. No. 88F0006XIE, Working paper No. 05, Science, Innovation and Electronic Information Division (SIEID), Ottawa, Statistics Canada.

Statistics Canada, Science and Technology Redesign Project, 1997. Biotechnology Firm Survey - 1997, Ottawa, Statistics Canada.

Statistics Canada, 1999. Biotechnology Use and Development Survey – 1999, Science, Innovation and Electronic Information Division (SIEID), Ottawa, Statistics Canada.

Statistics Canada, 2001. Biotechnology Use and Development Survey – 2001, Science, Innovation and Electronic Information Division (SIEID), Ottawa, Statistics Canada.

Traoré, Namatié and Antoine Rose, 2003. Determinants of biotechnology utilization by the Canadian industry. Research Policy 32(10), pp. 1719-1735.

Traoré, Namatié, 2001. Canadian biotechnology industrial activities: features from the 1997 Biotechnology Survey, Cat. No. 88F0006XIE-012, SIEID, Ottawa, Statistics Canada.

Traoré, Namatié, Dominique Tourigny, Marie-Hélène St-Louis, et Claude-Andrée Ouimet. 2003. How is the Canadian Biotechnology Evolving: A Comparison of the 1997 and 1999 Biotechnology Use and Development Surveys, Cat. No. 88F0006XIE2003003, SIEID, Ottawa, Statistics Canada.

Traoré, Namatié, 2003. "Coming of Age: Biotech Revenues are on the Rise", Innovation Analysis Bulletin, Vol.5(1), February 2003.

Traoré, Namatié, 2004a. Canadian Biotechnology Firms' Creative Capacity: On the Role of Absorptive Capacity, Relational Capital, Learning, and Firm Characteristics. International Journal of Biotechnology, Vol.6(1), pp1-19.

Traoré, Namatié, 2004b. Biotechnology Use and Development Surveys: Methodology, issues, and responses, Cat. No. 88F0006XIE-No. 006, SIEID, Ottawa, Statistics Canada.

Villalonga, Belén, 1999. Intangible resources and the sustainability of competitive advantage. Strategy and Organization, Anderson School of Management, University of California, Los Angeles.

Appendix 1: Additional tables

Table A1: Number of firms that successfully raised financing capital by firm size, 1997, 1999 and 2001

	1997	1999		2001		
	Succeeded	Attempted	Succeeded	Attempted	Succeeded	Reached target
Firm size						
Small (49 employees or fewer)	89	149	118	156	109	56
Medium (50 to 149 employees)	11	24	15	23	16	13
Large (150 employees and over)	9	5	5	9	9	6
Total	**109**	**178**	**138**	**188**	**134**	**74**

Source: Statistics Canada

Table A2: Number of firms that successfully raised financing capital by sector, 1997, 1999 and 2001

	1997	1999		2001		
	Succeeded	Attempted	Succeeded	Attempted	Succeeded	Reached target
Sector						
Human health	56	104	84	126	94	50
Agriculture and food processing	25	43	34	39	29	16
Other[a]	28	31	20	23	11	8
Total	**109**	**178**	**138**	**188**	**134**	**74**

Source: Statistics Canada

[a] The Other sector includes Environment, Bio-informatics, Aquaculture, Forest Products, Mining/Energy/Petroleum/Chemicals

Table A3: Number of firms that successfully raised financing capital by stage of development, 1997, 1999 and 2001

	1997	1999		2001		
	Succeeded	Attempted	Succeeded	Attempted	Succeeded	Reached target
Stage of development						
R&D	59	49	43	57	45	24
Proof of concept/ confined field trials	17[a]	27	18	38	32	16
Product development/ unconfined field trials		20	20	29	19	13
Commercialization	33	82	57	63	38	22
Total	**109**	**178**	**138**	**188**	**134**	**74**

Source: Statistics Canada

[a] In 1997, firms at the proof of concept/confined field trials and those at the product development/unconfined field trials stages were under "product development/Field Trial Stage"

Table A4: Amount of capital raised by firm size, 1997, 1999 and 2001

	1997	1999	2001
	Total amount raised ($000,000)	Total amount raised ($000,000)	Total amount raised ($000,000)
Firm size			
Small (49 employees or fewer)	333	1,690	517
Medium (50 to 149 employees)	87	160	374
Large (150 employees and over)	47	297	89
Total	**467**	**2,147**	**980**

Source: Statistics Canada, 1997, 1999, 2001 Biotechnology Use and Development Surveys

Table A5: Amount of capital raised by sector, 1997, 1999 and 2001

	1997	1999	2001
	Total amount raised ($000,000)	**Total amount raised ($000,000)**	**Total amount raised ($000,000)**
Sector of activity			
Human health	331	867	858
Agriculture and food processing	62	87	72
Other [a]	74	1,193	50
Total	**467**	**2,147**	**980**

Source: Statistics Canada, 1997, 1999, 2001 Biotechnology Use and Development Surveys

Notes:

[a] The Other sector includes Environment, Bio-informatics, Aquaculture, Forest Products, Mining/Energy/Petroleum/Chemicals

Table: A6: Amount of capital raised by stage of development, 1997, 1999 and 2001

	1997	1999	2001
	Total amount raised ($000,000)	**Total amount raised ($000,000)**	**Total amount raised ($000,000)**
Stage of development			
R&D	200	305	234
Proof of concept/ confined field trials	122[a]	53	204
Product development/ unconfined field trials	..	293	252
Commercialization	145	1,496	290
Total	**467**	**2,147**	**980**

Source: Statistics Canada, 1997, 1999, 2001 Biotechnology Use and Development Surveys

[a] In 1997, proof of concept and product development stages were under "Development stage"

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